



DRAFT TECHNICAL MEMORANDUM

CH2MHILL

Updated Vapor Intrusion Evaluation, 163 River Road (Former Jono's Restaurant), Block 93, Edgewater, NJ

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1.0 Summary

This memorandum summarizes the results from an evaluation of the potential vapor intrusion pathway at the building located at 163 River Road, on Block 93; the former Jono's Restaurant building (the "Building") is located at this address. This memorandum provides additional data that supplements a previously conducted evaluation¹ of potential vapor intrusion pathways at the Building. That previous evaluation, submitted in April 2007, had reviewed the existing site characterization data at Block 93 and concluded that potential vapor intrusion pathways were unlikely to be complete in the Building. In June 2007, groundwater sampling and a geophysical survey were conducted to provide further lines of evidence regarding potential vapor intrusion pathways at the Building.

The results from the June 2007 groundwater sampling event reinforce the overall assessment, originally presented in the April 2007 vapor intrusion evaluation, that a potential vapor intrusion pathway is not present in the Building. Key conclusions from these two studies are:

- Soil gas concentrations of naphthalene, estimated from concentrations detected in groundwater samples collected several feet below the water table near the footprint of the Building, are lower than site-specific risk-based screening levels. These screening levels are based on the individuals with the highest frequency and duration of potential exposure (workers in the restaurant).
- As discussed in the April 2007 vapor intrusion evaluation, the building characteristics may preclude a vapor intrusion pathway.
- A geophysical survey was performed to identify subsurface utilities that could be located near the Building. Based on this survey, the presence of subsurface features, such as municipal utilities, does not appear to affect the potential for a vapor intrusion pathway into the Building.

¹ CH2M HILL. 2007. Vapor Intrusion Evaluation at 163 River Road Building (Jono's Restaurant). April 12, 2007.

2.0 Introduction

This memorandum presents the results from shallow groundwater samples collected near the former Jono's Restaurant and Cantina building (the "Building"), at 163 River Road, Edgewater, New Jersey. This building is located on the Block 93 Parcel across River Road from the Quanta Resources property. The building is currently undergoing renovations and will be reopened as another restaurant.

The purpose for collecting groundwater samples was to follow up from a previously-conducted evaluation of the potential for indoor vapor intrusion pathways near the Building. That evaluation, conducted in April 2007, summarized the results of previous investigations which detected volatile and semi-volatile organic compounds in soil and groundwater at Block 93, and presented the results from the survey of the building.² The overall assessment in April 2007 was that potential vapor intrusion pathways were not present in the restaurant building. Further investigation was recommended to confirm the results from that April 2007 evaluation.

Further investigation of potential vapor intrusion pathways around the building consisted of the following activities:

- Collecting grab samples from shallow groundwater using low-flow sampling techniques and analyzing these samples for volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs)³;
- Performing a geophysical survey around the building, to identify subsurface utilities that potentially represent preferential pathways for the migration of soil vapor into the Building.

² CH2M HILL. 2007. Vapor Intrusion Evaluation at 163 River Road Building (Jono's Restaurant), April 12, 2007.

³ The April 2007 evaluation originally recommended collection of shallow soil gas samples. Based on the groundwater elevation around the Building (groundwater occurs at less than 5 feet below ground surface), soil gas sampling was deemed to not be feasible. Shallow groundwater sampling was proposed instead.

3.0 Sampling Methods

3.1 Groundwater Grab Sampling

The April 2007 vapor intrusion evaluation recommended collection of soil gas samples to provide additional lines of evidence regarding potential vapor intrusion pathways near the Building. Further review of groundwater elevations in monitoring wells near the building indicated that collection of soil gas samples might not be feasible. The New Jersey Department of Environmental Protection (NJDEP) provides guidance for the installation of soil gas samples for evaluation of potential vapor intrusion pathways (NJDEP, 2007). NJDEP recommends that soil gas samples be collected at a minimum depth of 5 feet below the ground surface, and one foot above the capillary fringe. The depth to groundwater near the Building precluded collection of soil gas samples in this manner (note: USEPA does not provide guidelines for the installation of soil gas probes for use in vapor intrusion investigations). Therefore, instead of soil gas samples, shallow groundwater samples were collected using low-flow sampling techniques.

Temporary well points were installed to collect the groundwater grab samples (see Figure 1 for the locations of these well points). Description of the well point installations will be included in the Draft RI Report for OU1. Originally, 1-foot screens associated with the temporary monitoring wells were to be installed at shallower depths such that the screens were just below the water table (5-6 feet bgs)⁴. This was attempted at location TWP-SB-33, however, the length of the well screen, the limited hydraulic conductivity of the saturated soils and the inability to create a significant hydraulic head variance between the shallow well and the adjacent formation resulted in very low recharge rates. As a result, purging and sampling at this location took approximately 10 hours. Based on the experience at this location, the remainder of the temporary well points was installed to greater depths below the water table, but no deeper than approximately 5.5 feet below the water table. The depth to water at each sample location, and depth at which groundwater was sampled are presented in Table 1. The effect of this deviation in the sampling approach on the evaluation of potential vapor intrusion pathways is discussed in further detail in this memorandum.

Field parameters that were collected were depth to groundwater, pH, conductivity, turbidity, dissolved oxygen (D.O.), temperature, and oxidation reduction potential (ORP). The field parameters are summarized in Table 1. The effect of these field conditions on potential vapor intrusion pathways is discussed in further detail in this memorandum.

3.2 Evaluation of Subsurface Utilities

NJDEP's vapor intrusion guidance (NJDEP, 2007) recommends canvassing the area around a building to identify subsurface utilities. Correspondingly, a survey was conducted to identify subsurface utilities in proximity to the Building. Attempts were made to obtain engineering and utility drawings from the Borough of Edgewater, but none apparently exist. In the absence of other information regarding subsurface utilities, Enviroscan, Inc.

⁴ As discussed below in this memorandum, agency guidelines state that groundwater samples from the top of the water table provide the best indication of potential vapor intrusion pathways (USEPA, 2002; NJDEP, 2007).

conducted a subsurface utility survey using geophysical survey techniques (Enviroscan, 2007). This survey identified the following utilities or linear features within 100 feet of the building (see Figure 2):

- A water line running from southeast to northwest, approximately 50 feet to the south of the Building, and parallel to the Building. An unidentified linear feature (referred to as a "linear anomaly") is adjacent to the water line. The groundwater grab sample location closest to this utility is TWP-SB30.
- A gas line running from southeast to northwest adjacent to the Building. The groundwater grab sampling location closest to this utility, and the Building, is TWP-SB29.
- An unidentified linear feature running from north to south, and adjacent to the Building. The groundwater grab sampling location closest to this feature is TWP-SB28. This possibly represents a water or sewer line.

4.0 Analytical Results

The groundwater samples were collected and analyzed for VOCs and SVOCs in accordance with the methods provided in the Quality Assurance Project Plan (QAPP) for the Quanta Resources site (CH2M HILL, 2005). Analytical results from the groundwater samples are presented in Attachment A. The primary constituents detected in groundwater were aromatic volatile hydrocarbons; specifically benzene, toluene, ethylbenzene and xylenes (BTEX), and polycyclic aromatic hydrocarbons.

5.0 Vapor Intrusion Evaluation

An evaluation of the potential for a vapor intrusion pathway into the Building was conducted using the groundwater monitoring data. The vapor intrusion evaluation consisted of the following steps:

- Identify the constituents of interest for vapor intrusion;
- Compare the estimated soil gas concentrations with conservative screening levels;
- Develop the conceptual model of the potential vapor intrusion pathway (for the constituents of interest) and estimate soil gas concentrations corresponding to the concentrations in groundwater.

Constituents of interest were identified using the primary screening method presented in the U.S. Environmental Protection Agency's draft vapor intrusion guidance (USEPA, 2002). Those screening results are presented in Attachment B. Based on this screening process, the constituents warranting further evaluation for vapor intrusion potential were BTEX and naphthalene.

The concentrations of BTEX and naphthalene detected in groundwater were converted to estimated concentrations in soil gas, using analytical modeling, as described below. The estimated soil gas concentrations were compared with conservative risk-based screening levels presented in the vapor intrusion evaluation work plan approved by USEPA Region 2 (CH2M HILL, 2006). The risk-based screening levels presented in the work plan were derived from indoor air levels that were based on residential land use assumptions. These residential indoor air concentrations were converted to corresponding soil gas concentrations using the USEPA recommended attenuation factor of 0.1 (USEPA, 2002).

The maximum soil gas concentration that may be derived from a specified groundwater concentration located at a specific depth below the soil gas-water interface was calculated using the steady-state analytical solution provided by Barber et al., 1990 (see Table 2). This calculation is based on Fick's Law of diffusion and uses equilibrium Henry's Law partitioning at the soil gas-water interface. This modeling is based on studies indicating that groundwater concentrations at little as 1 meter below the water table are unlikely to create significant soil gas signatures in the overlying vadose zone. Overlying ground water can greatly impede volatile constituents in deeper ground water from reaching the unsaturated zone, thus possibly preventing or limiting a vapor intrusion situation (Rivett, 1995; NJDEP, 2007). Further description of the conceptual model supporting the assumptions underlying this modeling is presented below.

Data collected during Remedial Investigation (RI) activities as recently suggests that coal tar is present in the eastern portion of Block 93, at a depth of approximately 10 ft below grade or more, and greater than 100 ft from the edge of the Building. This coal tar represents dense non-aqueous phase liquid (DNAPL), which is several feet below the water table. Soluble contaminants (such as naphthalene) may dissolve from the DNAPL. These would migrate towards the Building via diffusion and groundwater transport (there is a very slight groundwater gradient towards the west, based on the differences in water levels between MW-101 and MW-111; see Figure 3-6 in the RI Report). During the June 2007 Vapor

Intrusion Evaluation and Cinder Evaluation field efforts an isolated occurrence of 'black' NAPL was observed in the soil between 10 and 12 feet below grade at TWP-SB-30 which is located a distance of approximately 20 feet from the southern corner of the former Jono's Restaurant building. Groundwater grab samples collected at this location were taken from 1 foot above this impacted interval in order to best characterize the effects of this NAPL on groundwater concentrations and ultimately soil vapor and indoor air.

Prior to June 2007, the area between River Road and the Building was unpaved, allowing the infiltration of precipitation.⁵ The NJDEP observes, [a]s ground water moves away from the source area, infiltrating water that reaches the water table will lie on top of the contaminated ground water and, gradually, a lens of clean ground water may form above a contaminant plume". This lens may increase distance for liquid-phase diffusion and limit transport to the overlying soil gas. Because the rate of diffusion of contaminants through the overlying clean ground water is so slow, the overlying ground water can greatly impede or prevent volatiles in deeper ground water from reaching the unsaturated zone, thus possibly preventing a vapor intrusion situation (NJDEP, 2007; Fitzpatrick & Fitzgerald 2002; McAlary et al. 2004). Since the potential source for dissolved volatile constituents lies several feet below the water table and was for the most part over 100 feet away from the Building, it was assumed that a lens of groundwater with low or non-detectable concentrations was present over the concentrations detected in samples near the Building.

The soil gas concentrations of BTEX and naphthalene, estimated using the modeling presented in Table 2, were first compared with default residential risk-based screening levels. The comparison of modeled soil gas concentrations with the default residential screening levels is shown in Table 3. The results from that screening indicated that naphthalene is the only constituent which might warrant further evaluation. Further evaluation of the naphthalene results is presented below.

The conceptual model of conditions around the Building is shown in Figure 3. Concentrations of naphthalene in groundwater were relatively lower to the north (TWP-SB28) and east (TWP-SB29) of the Building. Naphthalene was not detected in groundwater in sample TWP-SB29, approximately 30 feet east of the Building. The highest concentration was detected in a grab sample located to the southeast of the Building (sample TWP-SB30). The naphthalene concentration detected in TWP-SB30 was from a groundwater sample collected approximately six feet below the water table and one foot above an interval found to contain NAPL, which provided a soil gas concentration only slightly higher than the default residential risk-based level. However, the land use at the restaurant is not residential; building occupants would consist of workers and restaurant patrons. Therefore, a site-specific soil gas screening level was developed to evaluate potential vapor intrusion pathways for naphthalene. The calculation of that site-specific screening level is presented below.

Workers have a higher frequency and duration of exposure, and would represent the most conservative exposure scenario in the Building (restaurant patrons would enter the building infrequently and only for limited periods of time). Based on this consideration, a site-specific indoor air screening level was calculated using USEPA's default assumptions for a

⁵ This area was paved with asphalt in June 2007 to create a parking lot for the reopened restaurant. This will reduce infiltration and possibly reduce the clean groundwater lens effect over time.

worker exposure scenario. That indoor air screening level was converted to a soil gas screening level with the same attenuation factor (a factor of 0.1) used to calculate the default residential soil gas screening levels. Derivation of that screening level and a site-specific evaluation of estimated naphthalene concentrations in soil gas are presented in Table 4.

The results from the screening presented in Table 4 show that estimated soil gas concentrations fall below a site-specific risk-based level (i.e. a non-cancer hazard quotient of one) at all sampling locations except TWP-SB33. However, as shown in Figure 3, that sample location is over 100 feet away from the building, which limits the potential for vapor intrusion into the Building from groundwater at that location.

The locations of subsurface utilities overlain with the naphthalene concentrations in groundwater are also shown in Figure 3. The sample location TWP-SB30 is in proximity to a linear anomaly that is located approximately 20 feet from the Building. The sample location TWP-SB28 is near a linear anomaly which runs south towards the Building. However, the naphthalene concentration in groundwater at sample TWP-SB28 corresponds to an estimated soil gas concentration which is lower than a default residential risk-based screening level. The lower concentration of naphthalene detected at this location, and the distance from the Building (approximately 100 feet), limits the potential for vapor intrusion from groundwater at this location.

The overall assessment of potential vapor intrusion pathways in the Building is based on the following factors, as developed from information in the previously-conducted evaluation (April 2007), and information obtained during this sampling event:

- Naphthalene has been detected in groundwater near the footprint of the Building. The naphthalene concentrations in groundwater nearest the Building are several feet below the water table. The state of New Jersey's guidance for vapor intrusion investigation states that sites with a clean groundwater lens at least 3 feet above contaminated groundwater are not likely to be associated with significant offgassing or vapor intrusion (NJDEP, 2007). As described previously, a clean groundwater lens may be present near the Building, based on the conceptual model of the release and transport of volatile constituents from the Quanta Site. The effect of this clean lens may decrease over time, due to paving around the site, performed in June 2007. However, this is unlikely to result in increased risk of vapor intrusion in the future, because concentrations in groundwater around the Building will not remain static. Remedial actions to be conducted for the Quanta Site in the future are anticipated to reduce source materials (DNAPL) and concentrations in groundwater, further reducing the potential risk of vapor intrusion in the Building.
- Soil gas concentrations of naphthalene from groundwater near the Building were estimated using analytical modeling, based on the assumption that overlying groundwater would impede volatile constituents in deeper ground water from reaching the unsaturated zone, thus possibly limiting vapor intrusion.
- The estimated soil gas concentrations are slightly higher than default risk-based concentrations that are based on residential land use assumptions. However, the land use at the restaurant is not residential; building occupants would consist of workers and restaurant patrons. Site-specific risk-based concentrations were calculated based on the

workers, who are likely to have the highest frequency and duration of exposure. The estimated soil gas concentrations fall below a site-specific risk-based level (i.e. a non-cancer hazard quotient of one) at all sampling locations except one location that is over 100 feet away from the building. There is limited potential for vapor intrusion into the Building from groundwater at that location.

- Inhabited areas are generally elevated 1.5 to 3 ft above the ground surface. The slab underlying the building is relatively thick (from 6 inches to 2 feet), and is in good condition with relatively few penetrations. There is an approximate 4 inch annular space above the floor in the inhabited areas. This annular space is located under the dining room floor, and is filled with insulation. The dining area contains an upstairs portion, providing an approximate ceiling height of 20 feet. The ceiling height in the kitchen and store room is approximately 8 to 10 ft. The restaurant does not have a central air conditioning unit, though the gas-fired ranges in the kitchen are equipped with hoods and exhaust fans. As discussed in the April 2007 vapor intrusion evaluation, the building characteristics may preclude a vapor intrusion pathway.
- The locations of subsurface utilities and other subsurface features around the building were identified using geophysical methods. The highest naphthalene concentration in groundwater were detected near one “linear anomaly” (sample TWP-SB300; however this feature is located approximately 20 feet from the Building, and does not intersect with the Building foundation, and does not create a pathway to the Building. A second linear anomaly traverses north to south, and intersects with the Building; however concentrations of naphthalene in groundwater in this area are lower, and the corresponding soil gas concentrations do not exceed risk-based screening levels. The presence of these subsurface features does not appear to affect the potential for a vapor intrusion pathway into the Building.

6.0 Conclusions

The following conclusions are based on the results from the groundwater sampling event conducted in June 2007, and the previously-conducted vapor intrusion evaluation in April 2007:

- Soil gas concentrations of naphthalene, estimated from concentrations detected several feet in groundwater near the footprint of the Building, are lower than site-specific risk-based screening levels. These screening levels are based on the individuals with the highest frequency and duration of potential exposure (workers in the restaurant).
- As discussed in the April 2007 vapor intrusion evaluation, the building characteristics may preclude a vapor intrusion pathway.
- The presence of subsurface features, such as municipal utilities, does not appear to affect the potential for a vapor intrusion pathway into the Building.

The results from the June 2007 groundwater sampling event reinforce the overall assessment, originally provided in the April 2007 evaluation, that a potential vapor intrusion pathway is not present in the Building.

7.0 References

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Tables

Table 1

Field Parameters from Groundwater Grab Samples

Block 93 Vapor Intrusion Evaluation

Edgewater, NJ

Well Number	Property	pH	Temp. (° C)	Depth to Water (ft)	Well Depth (ft)	Conductivity (mS/cm)	ORP (mV)	DO (mg/L)	Turbidity (NTU)	Comments
TWP-SB28	Block 93 North	6.69	21.67	5.5	7.2	0.033	-150.1	0.99	38.7	Clear/None
TWP-SB29	Block 93 North	6.67	18.31	5.21	10.81	6.819	-171.9	1.07	13	Clear/None
TWP-SB30	Block 93 North	6.83	17.89	3.98	10.85	0.018	-180.8	0.17	116	Clear/None
TWP-SB31	Block 93 North	7.25	15.09	5.43	10.85	0.43	-182	4.02	19	Clear/None
TWP-SB32	Block 93 North	7.13	15.81	3.34	7.71	1.604	-180.8	2	17.3	Clear/None
TWP-SB33	Block 93 North	8.02	18.96	6.65	7.5	1.212	120.7	1.95	12	Clear/None

Notes:

ORP - Oxidizing-reducing potential

DO - Dissolved oxygen

ORP results less than zero indicate the presence of reducing conditions in groundwater.

Measurement Units:

mL/min - milliliters per minute

mS/cm - milliSiemens per centimeter

NTU - Nephelometric turbidity unit

mV - millivolt

Table 2

Steady-State Diffusion Modeling in Groundwater for Estimation of Soil Gas Concentrations

Block 93 Vapor Intrusion Evaluation

Edgewater, New Jersey

Chemical	C _o (µg/L)	C _{go} (µg/m ³)	D _g (cm ² /s)	D _w (cm ² /s)	L _g (cm)	X _w (cm)	Henry's Law Constant	C _o (µg/cm ³)	C _{go} (µg/cm ³)	C _{gi} (µg/cm ³)	C _{gi} (µg/m ³)
TWP-SB28											
Benzene	2.4	0	0.088	0.0000098	168	219	0.197	0.0024	0	2.05E-07	2.05E-01
Ethylbenzene	5.9	0	0.075	0.0000078	168	219	0.269	0.0059	0	4.71E-07	4.71E-01
Toluene	2.6	0	0.087	0.0000086	168	219	0.231	0.0026	0	1.97E-07	1.97E-01
Xylene (total)	4.2	0	0.0769	0.00000844	168	219	0.261	0.0042	0	3.54E-07	3.54E-01
Naphthalene	223	0	0.059	0.0000075	168	219	0.016	0.223	0	2.16E-05	2.16E+01
TWP-SB29											
Benzene	0.5	0	0.088	0.0000098	168	219	0.197	0.0005	0	4.27E-08	4.27E-02
Ethylbenzene	0.5	0	0.075	0.0000078	168	219	0.269	0.0005	0	3.99E-08	3.99E-02
Toluene	0.5	0	0.087	0.0000086	168	219	0.231	0.0005	0	3.79E-08	3.79E-02
Xylene (total)	0.5	0	0.0769	0.00000844	168	219	0.261	0.0005	0	4.21E-08	4.21E-02
Naphthalene	0.105	0	0.059	0.0000075	168	219	0.016	0.000105	0	1.02E-08	1.02E-02
TWP-SB30											
Benzene	44.1	0	0.088	0.0000098	121	331	0.197	0.0441	0	1.79E-06	1.79E+00
Ethylbenzene	21.7	0	0.075	0.0000078	121	331	0.269	0.0217	0	8.25E-07	8.25E-01
Toluene	2.0	0	0.087	0.0000086	121	331	0.231	0.002	0	7.23E-08	7.23E-02
Xylene (total)	17.1	0	0.0769	0.00000844	121	331	0.261	0.0171	0	6.86E-07	6.86E-01
Naphthalene	873	0	0.059	0.0000075	121	331	0.016	0.873	0	4.05E-05	4.05E+01
TWP-SB31											
Benzene	28.9	0	0.088	0.0000098	166	331	0.197	0.0289	0	1.61E-06	1.61E+00
Ethylbenzene	28.4	0	0.075	0.0000078	166	331	0.269	0.0284	0	1.48E-06	1.48E+00
Toluene	17.3	0	0.087	0.0000086	166	331	0.231	0.0173	0	8.57E-07	8.57E-01
Xylene (total)	30.2	0	0.0769	0.00000844	166	331	0.261	0.0302	0	1.66E-06	1.66E+00
Naphthalene	457	0	0.059	0.0000075	166	331	0.016	0.457	0	2.90E-05	2.90E+01

Table 2

Steady-State Diffusion Modeling in Groundwater for Estimation of Soil Gas Concentrations

Block 93 Vapor Intrusion Evaluation

Edgewater, New Jersey

Chemical	C _o (µg/L)	C _{go} (µg/m ³)	D _g (cm ² /s)	D _w (cm ² /s)	L _g (cm)	X _w (cm)	Henry's Law Constant	C _o (µg/cm ³)	C _{go} (µg/cm ³)	C _{gi} (µg/cm ³)	C _{gi} (µg/m ³)
TWP-SB32											
Benzene	0.5	0	0.088	0.0000098	166	331	0.197	0.0005	0	2.79E-08	2.79E-02
Ethylbenzene	0.5	0	0.075	0.0000078	166	331	0.269	0.0005	0	2.61E-08	2.61E-02
Toluene	0.5	0	0.087	0.0000086	166	331	0.231	0.0005	0	2.48E-08	2.48E-02
Xylene (total)	0.5	0	0.0769	0.00000844	166	331	0.261	0.0005	0	2.75E-08	2.75E-02
Naphthalene	0.644	0	0.059	0.0000075	166	331	0.016	0.000644	0	4.09E-08	4.09E-02
TWP-SB33											
Benzene	94.3	0	0.088	0.0000098	203	229	0.197	0.0943	0	9.30E-06	9.30E+00
Ethylbenzene	22.3	0	0.075	0.0000078	203	229	0.269	0.0223	0	2.06E-06	2.06E+00
Toluene	3.3	0	0.087	0.0000086	203	229	0.231	0.0033	0	2.89E-07	2.89E-01
Xylene (total)	18.8	0	0.0769	0.00000844	203	229	0.261	0.0188	0	1.83E-06	1.83E+00
Naphthalene	533	0	0.059	0.0000075	203	229	0.016	0.533	0	5.96E-05	5.96E+01

Note: Concentrations are assumed present at 1/2 the reporting limit for constituents reported as not detected.

µg/cm³ - micrograms per cubic centimeter

µg/L - micrograms per liter

µg/m³ - micrograms per cubic metercm²/s - square centimeters per second

Table 2

Steady-State Diffusion Modeling in Groundwater for Estimation of Soil Gas Concentrations
 Block 93 Vapor Intrusion Evaluation
 Edgewater, New Jersey

Description	Symbol	Units	Comments
Gas-phase concentration immediately adjacent to the air-water interface	C_{gi}	ug/cm ³	
Gas-phase concentration near the ground surface	C_{go}	ug/cm ³	Assumed to be zero to estimate only the contribution from groundwater
Depth of the unsaturated zone	L_g	cm	
Groundwater concentration at depth below water table	C_o	ug/cm ³	
Depth below water table	X_w	cm	
Liquid-phase diffusion coefficient	D_w	cm ² /s	
Gas-phase diffusion coefficient	D_g	cm ² /s	

$$C_{gi} = \frac{C_{go} + \left(\frac{L_g \times D_w \times C_o}{X_w \times D_g} \right)}{1 + \left(\frac{L_g \times D_w}{X_w \times D_g \times H} \right)}$$

Steady-State Diffusion Modeling in Groundwater for Estimation of Soil Gas Concentrations - long version (for values of H > 0.01):

This is a calculation of the maximum soil gas concentration that may be derived from a specified groundwater concentration. This calculation uses the steady-state analytical solution provided by Barber et al., 1990. It is based on a concentration in groundwater located at a depth below the soil gas-water interface. It is based on Fick's Law of diffusion and uses equilibrium Henry's Law partitioning at the soil gas-water interface.

Sources: Barber et al., 1990; Rivett, 1995; CSIRO, 2004

Well Number	Temp. (° C)	Depth to Water (ft)	Well Depth (ft)	Depth to Water (cm)	Well Depth (cm)
TWP-SB28	21.67	5.5	7.2	168	219
TWP-SB29	18.31	5.21	10.81	159	329
TWP-SB30	17.89	3.98	10.85	121	331
TWP-SB31	15.09	5.43	10.85	166	331
TWP-SB32	15.81	3.34	7.71	102	235
TWP-SB33	18.96	6.65	7.5	203	229

Table 3
Comparison of Modeled Soil Gas Concentrations with Default Residential Risk-Based Screening Levels
Block 93 Vapor Intrusion Evaluation
Edgewater, New Jersey

Chemical	Concentration in Groundwater (ug/L)	Modeled Concentration in Soil Gas (ug/m ³)	Screening Based on Default Residential Assumptions									
			Soil Gas Screening Levels					Soil Gas Concentrations Exceed Screening Levels?				
			10 ⁻⁶	10 ⁻⁵	10 ⁻⁴	HQ=0.1	HQ=1	10 ⁻⁶	10 ⁻⁵	10 ⁻⁴	HQ=0.1	HQ=1
TWP-SB28												
Benzene	2.4	2.05E-01	2.49E+00	2.49E+01	2.49E+02	3.14E+01	3.14E+02	N	N	N	N	N
Ethylbenzene	5.9	4.71E-01				1.06E+03	1.06E+04				N	N
Toluene	2.6	1.97E-01				4.20E+02	4.20E+03				N	N
Xylene (total)	4.2	3.54E-01				1.06E+02	1.06E+03				N	N
Naphthalene	223	2.16E+01				3.13E+00	3.13E+01				Y	N
TWP-SB29												
Benzene	0.5	4.27E-02	2.49E+00	2.49E+01	2.49E+02	3.14E+01	3.14E+02	N	N	N	N	N
Ethylbenzene	0.5	3.99E-02				1.06E+03	1.06E+04				N	N
Toluene	0.5	3.79E-02				4.20E+02	4.20E+03				N	N
Xylene (total)	0.5	4.21E-02				1.06E+02	1.06E+03				N	N
Naphthalene	0.105	1.02E-02				3.13E+00	3.13E+01				N	N
TWP-SB30												
Benzene	44.1	1.79E+00	2.49E+00	2.49E+01	2.49E+02	3.14E+01	3.14E+02	N	N	N	N	N
Ethylbenzene	21.7	8.25E-01				1.06E+03	1.06E+04				N	N
Toluene	2.0	7.23E-02				4.20E+02	4.20E+03				N	N
Xylene (total)	17.1	6.86E-01				1.06E+02	1.06E+03				N	N
Naphthalene	873	4.05E+01				3.13E+00	3.13E+01				Y	Y
TWP-SB31												
Benzene	28.9	1.61E+00	2.49E+00	2.49E+01	2.49E+02	3.14E+01	3.14E+02	N	N	N	N	N
Ethylbenzene	28.4	1.48E+00				1.06E+03	1.06E+04				N	N
Toluene	17.3	8.57E-01				4.20E+02	4.20E+03				N	N
Xylene (total)	30.2	1.66E+00				1.06E+02	1.06E+03				N	N
Naphthalene	457	2.90E+01				3.13E+00	3.13E+01				Y	N
TWP-SB32												
Benzene	0.5	2.79E-02	2.49E+00	2.49E+01	2.49E+02	3.14E+01	3.14E+02	N	N	N	N	N
Ethylbenzene	0.5	2.61E-02				1.06E+03	1.06E+04	N	N	N	N	N
Toluene	0.5	2.48E-02				4.20E+02	4.20E+03	N	N	N	N	N
Xylene (total)	0.5	2.75E-02				1.06E+02	1.06E+03	N	N	N	N	N
Naphthalene	0.644	4.09E-02				3.13E+00	3.13E+01	N	N	N	N	N
TWP-SB33												
Benzene	94.3	9.30E+00	2.49E+00	2.49E+01	2.49E+02	3.14E+01	3.14E+02	Y	N	N	N	N
Ethylbenzene	22.3	2.06E+00				1.06E+03	1.06E+04	N	N	N	N	N
Toluene	3.3	2.89E-01				4.20E+02	4.20E+03	N	N	N	N	N
Xylene (total)	18.8	1.83E+00				1.06E+02	1.06E+03	N	N	N	N	N
Naphthalene	533	5.96E+01				3.13E+00	3.13E+01	N	N	N	Y	Y

Note: Concentrations are assumed present at 1/2 reporting limit for constituents reported as not detected.
µg/L - micrograms per liter
µg/m³ - micrograms per cubic meter

Table 4
Site-Specific Evaluation of Potential Vapor Intrusion
Block 93 Vapor Intrusion Evaluation
Edgewater, NJ

Groundwater Monitoring Location	Naphthalene Concentration in Groundwater (µg/L)	Modeled Concentration in Soil Gas (µg/m³)	Screening Based on Site-Specific Assumptions				Comments
			Soil Gas Screening Levels		Soil Gas Concentrations Exceed Screening Levels?		
			HQ=0.1	HQ=1	HQ=0.1	HQ=1	
TWP-SB28	223	2.16E+01	4.4E+00	4.4E+01	Y	N	
TWP-SB29	0.105	1.02E-02	4.4E+00	4.4E+01	N	N	
TWP-SB30	873	4.05E+01	4.4E+00	4.4E+01	Y	N	
TWP-SB31	457	2.90E+01	4.4E+00	4.4E+01	Y	N	
TWP-SB32	0.644	4.09E-02	4.4E+00	4.4E+01	N	N	
TWP-SB33	533	5.96E+01	4.4E+00	4.4E+01	Y	Y	This groundwater sample was more than 100 feet from the Building, reducing the potential for vapor intrusion from this location.

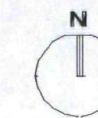
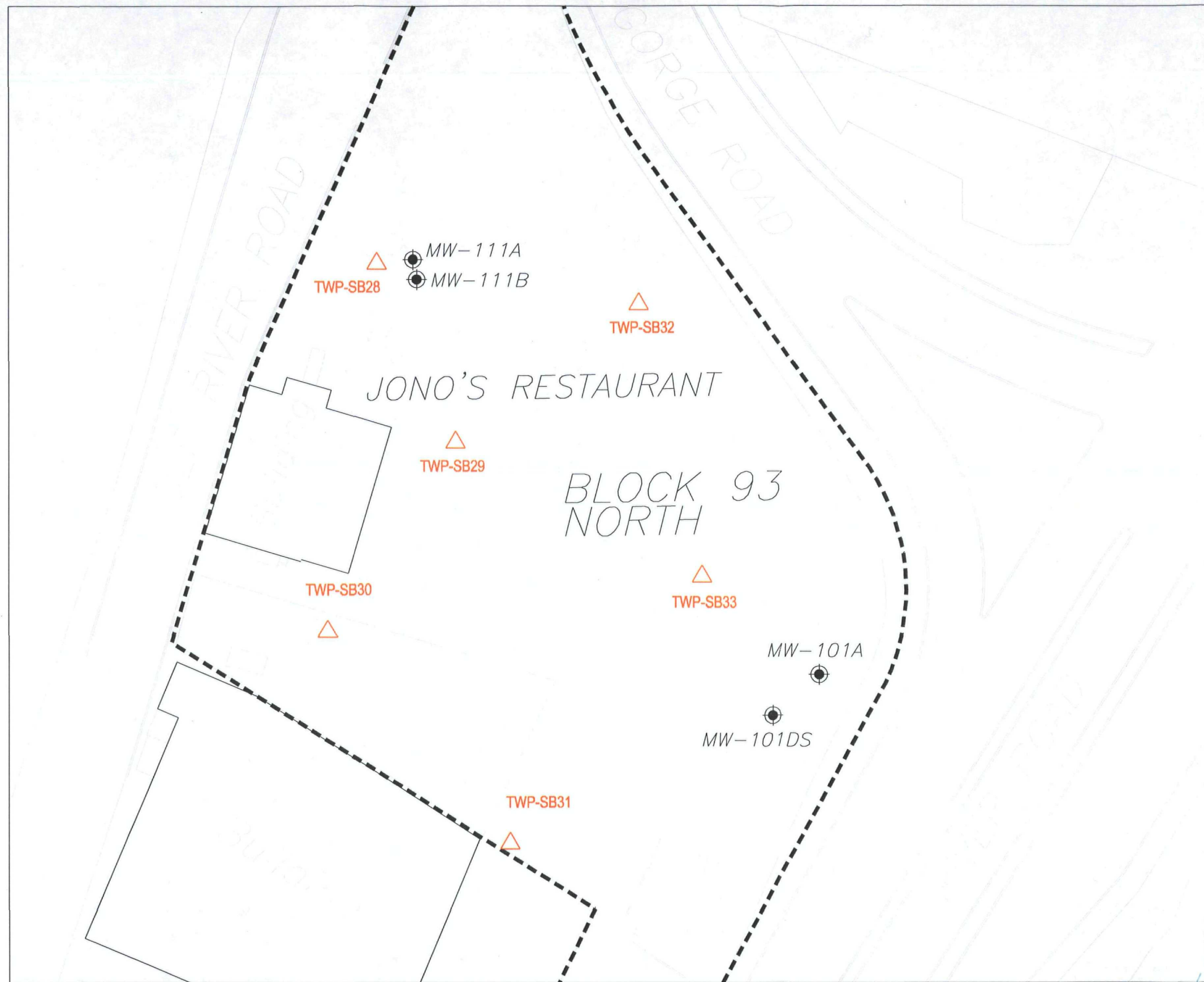
Note: Concentrations are assumed present at 1/2 the reporting limit for constituents reported as not detected.
The soil gas screening level was calculated from the indoor air screening level using an attenuation factor of 0.1.

CALCULATION OF SITE-SPECIFIC SCREENING LEVEL




Chemical	Inhalation Slope Factor (kg-day/mg)	Inhalation RfD (mg/kg-day)	Screening Levels in Indoor Air (µg/m ³)			Final Screening Level in Air (µg/m ³)
			Carcinogenic	Noncarcinogenic	Lowest Value	
NAPHTHALENE		8.57E-04		4.4E+00	4.4E+00	4.4E+00

EXPOSURE PARAMETERS	VALUE
Target cancer risk	1E-06
Target Hazard Quotient	1.0
Body weight, adult (kg)	70
Air breathed (m ³ /d)	20
Exposure frequency (d/yr)	250
Exposure duration (yr)	25.0
Averaging time - carcinogenic (yr)	70
Averaging time - noncarcinogenic (yr)	25.0

Figures

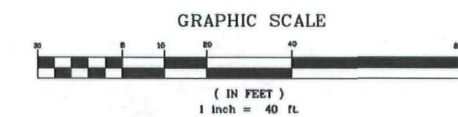


LEGEND

-  **TWP-SB29** GW GRAB WELL POINT LOCATION
-  **MW-101A** EXISTING MONITORING WELL
-  CURRENT BLOCK 93 NORTH PROPERTY BOUNDARY

Notes:

1. Property boundary lines are based on November 1959 Borough of Edgewater tax maps.
2. Property boundary lines are not exact.

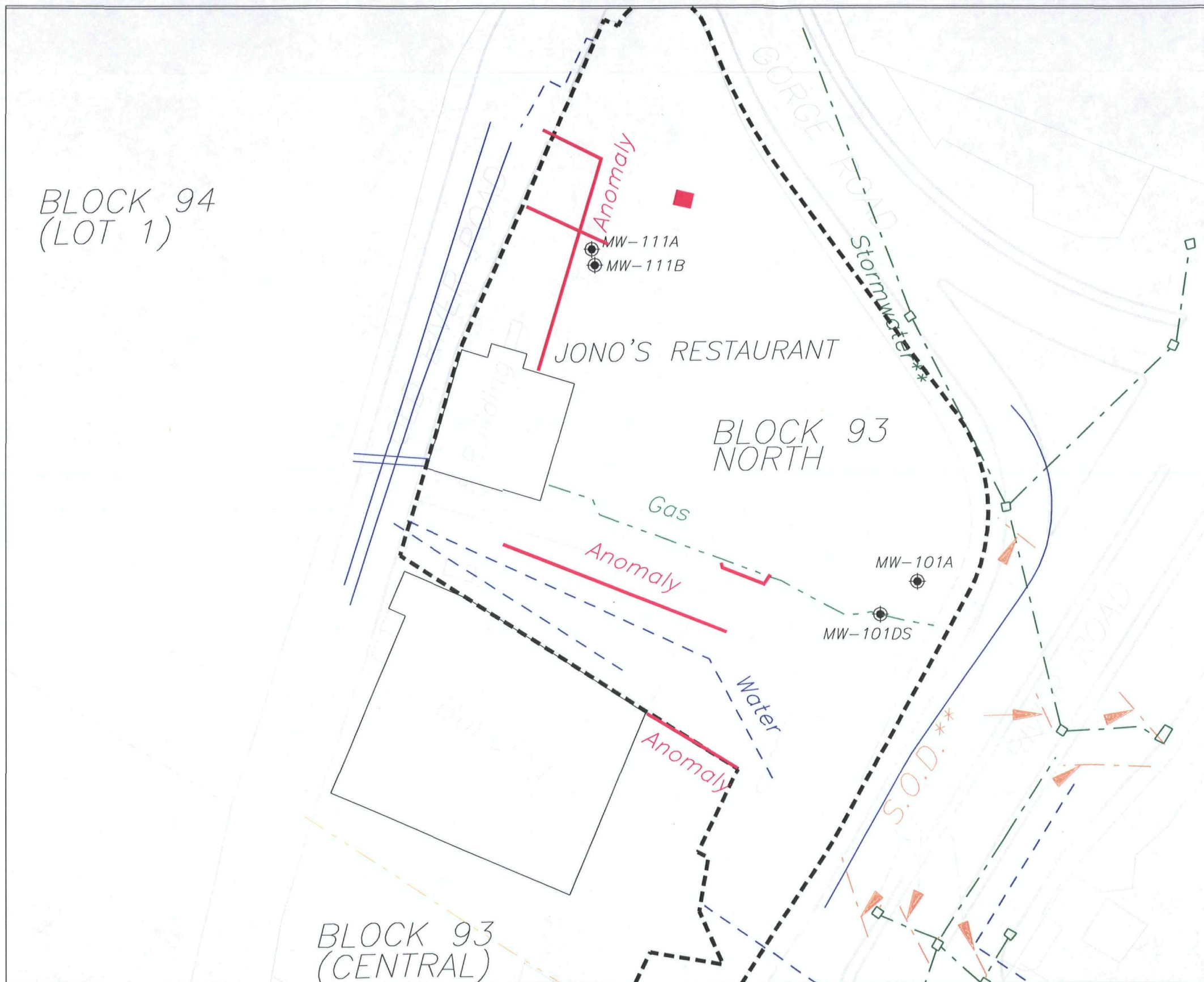


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**JONO'S RESTAURANT VAPOR
INTRUSION EVALUATION
GROUNDWATER GRAB LOCATIONS
QUANTA RESOURCES SUPERFUND SITE
Edgewater, New Jersey**

August 2007

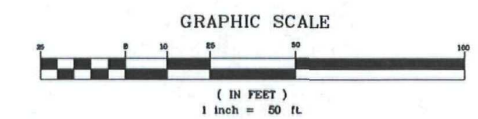
FIGURE 1



LEGEND

- △ TWP-SB29 GW GRAB WELL POINT LOCATION
- MW-101A EXISTING MONITORING WELL
- CURRENT BLOCK 93 NORTH PROPERTY BOUNDARY
- OBSERVED / APPARENT WATER LINE
- APPARENT STORMWATER LINE
- LINEAR ANOMALY
- SUB-BASE OUTLET DRAIN
- GAS LINE

- Notes:
1. Property boundary lines are based on November 1959 Borough of Edgewater tax maps.
 2. Property boundary lines are not exact.
 3. S.O.D.: Sub-base Outlet Drain
 4. The geophysical survey of Block 93 North was performed by Enviroscan, Inc. on May 31, 2007. Utilities and anomalies shown on Block 93 North were found during this survey.
 5. Other pipe and trench locations are approximate and are based on field observations and historical information sources including Sanborn Fire Insurance Maps and the Removal Site Investigation report (Geosyntec, 1998).



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**JONO'S RESTAURANT VAPOR
INTRUSION EVALUATION
BLOCK 93 NORTH UTILITY LOCATIONS
QUANTA RESOURCES SUPERFUND SITE
Edgewater, New Jersey**

August 2007	FIGURE 2
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Attachment A

Groundwater Sampling and Analytical Data

Table A-1 - Volatile Organic Compounds (VOCs) in Groundwater - All Analytical Results

Table A-2 - Volatile Organic Compounds (VOCs) in Groundwater - Detected Compounds

Table A-3 - Semi-Volatile Organic Compounds (SVOCs) in Groundwater - All Analytical
Results

Table A-4 - Semi-Volatile Organic Compounds (SVOCs) in Groundwater - Detected
Compounds

Table A-1
Volatile Organic Compounds (VOCs) in Groundwater - All Analytical Results
Block 93 Vapor Intrusion Evaluation
Edgewater, NJ

Parameter	Parameter Code	Units	Location:	TWP-SB28	TWP-SB29	TWP-SB30	TWP-SB31	TWP-SB31	TWP-SB32	TWP-SB33	
			Field Sample ID:	TWP-SB28-060507	TWP-SB29-060607	TWP-SB30-060507	DUP-060607-GW	TWP-SB31-060607	TWP-SB32-060607	TWP-SB33-060407	
			Date:	6/5/2007	6/6/2007	6/5/2007	6/6/2007	6/6/2007	6/6/2007	6/4/2007	
			Start Depth:	8	7.5	8	7.5	7.5	6.5	5	
			End Depth:	9	8.5	9	8.5	8.5	7.5	6	
			Depth Units:	ft	ft	ft	ft	ft	ft	ft	
Analytical Method											
1,1,1-TRICHLOROETHANE	71-55-6	µg/l	SW8260	1	U	1	U	1	U	1	U
1,1,2,2-TETRACHLOROETHANE	79-34-5	µg/l	SW8260	1	U	1	U	1	U	1	U
1,1,2-TRICHLOROETHANE	79-00-5	µg/l	SW8260	1	U	1	U	1	U	1	U
1,1,2-TRICHLOROTRIFLUOROETHANE	76-13-1	µg/l	SW8260	5	U	5	U	5	U	5	U
1,1-DICHLOROETHANE	75-34-3	µg/l	SW8260	1	U	1	U	1	U	1	U
1,1-DICHLOROETHENE	75-35-4	µg/l	SW8260	1	U	1	U	1	U	1	U
1,2,4-TRICHLOROBENZENE	120-82-1	µg/l	SW8260	5	U	5	U	5	U	5	U
1,2-DIBROMO-3-CHLOROPROPANE	1996-12-08	µg/l	SW8260	10	U	10	U	10	U	10	U
1,2-DIBROMOETHANE	106-93-4	µg/l	SW8260	2	U	2	U	2	U	2	U
1,2-DICHLOROBENZENE	95-50-1	µg/l	SW8260	1	U	1	U	1	U	1	U
1,2-DICHLOROETHANE	107-06-2	µg/l	SW8260	1	U	1	U	1	U	1	U
1,2-DICHLOROPROPANE	78-87-5	µg/l	SW8260	1	U	1	U	1	U	1	U
1,3-DICHLOROBENZENE	541-73-1	µg/l	SW8260	1	U	1	U	1	U	1	U
1,4-DICHLOROBENZENE	106-46-7	µg/l	SW8260	1	U	1	U	1	U	1	U
2-BUTANONE	78-93-3	µg/l	SW8260	10	UJ	10	UJ	10	U	10	UJ
2-HEXANONE	591-78-6	µg/l	SW8260	5	U	5	U	5	U	5	U
4-METHYL-2-PENTANONE	108-10-1	µg/l	SW8260	5	U	5	U	5	U	5	U
ACETONE	67-64-1	µg/l	SW8260	10	U	3.2	J	10	U	10	U
BENZENE	71-43-2	µg/l	SW8260	2.4		1	U	44.1		28.7	
BROMODICHLOROMETHANE	75-27-4	µg/l	SW8260	1	U	1	U	1	U	1	U
BROMOFORM	75-25-2	µg/l	SW8260	4	U	4	U	4	U	4	U
BROMOMETHANE	74-83-9	µg/l	SW8260	2	U	2	U	2	U	2	U
CARBON DISULFIDE	75-15-0	µg/l	SW8260	0.43	J	2	U	0.59	J	0.55	J
CARBON TETRACHLORIDE	56-23-5	µg/l	SW8260	1	U	1	U	1	U	1	U
CHLOROBENZENE	108-90-7	µg/l	SW8260	1	U	1	U	1	U	1	U
CHLORODIBROMOMETHANE	124-48-1	µg/l	SW8260	1	U	1	U	1	U	1	U
CHLOROETHANE	75-00-3	µg/l	SW8260	1	U	1	U	1	U	1	U
CHLOROFORM	67-66-3	µg/l	SW8260	1	U	1	U	1	U	1	U
CHLOROMETHANE	74-87-3	µg/l	SW8260	1	U	1	U	1	U	1	U
CIS-1,2-DICHLOROETHENE	156-59-2	µg/l	SW8260	1	U	1	U	1	U	1	U
CIS-1,3-DICHLOROPROPENE	10061-01-5	µg/l	SW8260	1	U	1	U	1	U	1	U
CYCLOHEXANE	110-82-7	µg/l	SW8260	5	U	5	U	1.9	J	1.7	J
DICHLORODIFLUOROMETHANE	75-71-8	µg/l	SW8260	5	U	5	U	5	U	5	U
ETHYLBENZENE	100-41-4	µg/l	SW8260	5.9		1	U	21.7		28.6	

J - Estimated Value; detected between the RL and MDL
ND - Not Detected
U - Analyte not detected above the MDL
D - Analyte reported from a diluted extract

Table A-1
Volatile Organic Compounds (VOCs) in Groundwater - All Analytical Results
Block 93 Vapor Intrusion Evaluation
Edgewater, NJ

Parameter	Parameter Code	Units	Location:	TWP-SB28	TWP-SB29	TWP-SB30	TWP-SB31	TWP-SB31	TWP-SB32	TWP-SB33			
			Field Sample ID:	TWP-SB28-060507	TWP-SB29-060607	TWP-SB30-060507	DUP-060607-GW	TWP-SB31-060607	TWP-SB32-060607	TWP-SB33-060407			
			Date:	6/5/2007	6/6/2007	6/5/2007	6/6/2007	6/6/2007	6/6/2007	6/4/2007			
			Start Depth:	8	7.5	8	7.5	7.5	6.5	5			
			End Depth:	9	8.5	9	8.5	8.5	7.5	6			
			Depth Units:	ft	ft	ft	ft	ft	ft	ft			
Analytical Method													
ISOPROPYLBENZENE	98-82-8	µg/l	SW8260	0.57	J	2	U	3.7	5.4	5.2	2	U	2.5
METHYL ACETATE	79-20-9	µg/l	SW8260	5	U	5	U	5	U	5	U	5	U
METHYL TERT-BUTYL ETHER	1634-04-4	µg/l	SW8260	1	U	0.98	J	0.62	J	1	U	1	U
METHYLCYCLOHEXANE	108-87-2	µg/l	SW8260	5	U	5	U	5	U	0.61	J	0.6	J
METHYLENE CHLORIDE	1975-09-02	µg/l	SW8260	2	U	2	U	2	U	2	U	2	U
STYRENE	100-42-5	µg/l	SW8260	5	U	5	U	5	U	5	U	5	U
TETRACHLOROETHENE	127-18-4	µg/l	SW8260	1	U	1	U	1	U	1	U	1	U
TOLUENE	108-88-3	µg/l	SW8260	2.6		1	U	2	17.4	17.3	1	U	3.3
TRANS-1,2-DICHLOROETHENE	156-60-5	µg/l	SW8260	1	U	1	U	1	U	1	U	1	U
TRANS-1,3-DICHLOROPROPENE	10061-02-6	µg/l	SW8260	1	U	1	U	1	U	1	U	1	U
TRICHLOROETHENE	1979-01-06	µg/l	SW8260	1	U	1	U	1	U	1	U	1	U
TRICHLOROFLUOROMETHANE	75-69-4	µg/l	SW8260	5	U	5	U	5	U	5	U	5	U
VINYL CHLORIDE	1975-01-04	µg/l	SW8260	1	U	1	U	1	U	1	U	1	U
O-XYLENE	95-47-6	µg/l	SW8260	1.8		1	U	7.1	9.8	9.6	1	U	6.1
XYLENES, M & P	XYLENES1314	µg/l	SW8260	2.4		1	U	10	20	20.5	1	U	12.7
XYLENES, TOTAL	1330-20-7	µg/l	SW8260	4.2		1	U	17.1	29.8	30.2	1	U	18.8

J - Estimated Value; detected between the RL and MDL
ND - Not Detected
U - Analyte not detected above the MDL
D - Analyte reported from a diluted extract

Table A-2
Volatile Organic Compounds (VOCs) in Groundwater - Detected Compounds
Block 93 Vapor Intrusion Evaluation
Edgewater, NJ

Parameter	Parameter Code	Units	Location:	TWP-SB28	TWP-SB29	TWP-SB30	TWP-SB31	TWP-SB31	TWP-SB33
			Field Sample ID:	TWP-SB28-060507	TWP-SB29-060607	TWP-SB30-060507	DUP-060607-GW	TWP-SB31-060607	TWP-SB33-060407
			Date:	6/5/2007	6/6/2007	6/5/2007	6/6/2007	6/6/2007	6/4/2007
			Start Depth:	8	7.5	8	7.5	7.5	5
			End Depth:	9	8.5	9	8.5	8.5	6
			Depth Units:	ft	ft	ft	ft	ft	ft
			Analytical Method						
ACETONE	67-64-1	µg/l	SW8260		3.2	J			
BENZENE	71-43-2	µg/l	SW8260	2.4		44.1	28.7	28.9	94.3
CARBON DISULFIDE	75-15-0	µg/l	SW8260	0.43	J	0.59	J	0.39	J
CYCLOHEXANE	110-82-7	µg/l	SW8260				1.9	J	J
ETHYLBENZENE	100-41-4	µg/l	SW8260	5.9		21.7	28.6	28.4	22.3
ISOPROPYLBENZENE	98-82-8	µg/l	SW8260	0.57	J	3.7	5.4	5.2	2.5
METHYL TERT-BUTYL ETHER	1634-04-4	µg/l	SW8260		0.98	J	0.62	J	1.1
METHYLCYCLOHEXANE	108-87-2	µg/l	SW8260				0.61	J	
TOLUENE	108-88-3	µg/l	SW8260	2.6		2	17.4	17.3	3.3
O-XYLENE	95-47-6	µg/l	SW8260	1.8		7.1	9.8	9.6	6.1
XYLENES, M & P	XYLENES1314	µg/l	SW8260	2.4		10	20	20.5	12.7
XYLENES, TOTAL	1330-20-7	µg/l	SW8260	4.2		17.1	29.8	30.2	18.8

J - Estimated Value; detected between the RL and MDL
ND - Not Detected
U - Analyte not detected above the MDL
D - Analyte reported from a diluted extract

Table A-3
Semi-Volatile Organic Compounds (SVOCs) in Groundwater - All Analytical Results
Block 93 Vapor Intrusion Evaluation
Edgewater, NJ

Parameter	Parameter Code	Units	Location:	TWP-SB28	TWP-SB29	TWP-SB30	TWP-SB31	TWP-SB31	TWP-SB32	TWP-SB33				
			Field Sample ID:	TWP-SB28-060507	TWP-SB29-060607	TWP-SB30-060507	DUP-060607-GW	TWP-SB31-060607	TWP-SB32-060607	TWP-SB33-060407				
			Date:	6/5/2007	6/6/2007	6/5/2007	6/6/2007	6/6/2007	6/6/2007	6/4/2007				
			Start Depth:	8	7.5	8	7.5	7.5	6.5	5				
			End Depth:	9	8.5	9	8.5	8.5	7.5	6				
Depth Units:	ft	ft	ft	ft	ft	ft	ft							
Analytical Method														
1,1'-BIPHENYL	92-52-4	µg/l	SW8270	5.8	2.1	U	6	8.1	9	2.2	U	2.1	J	
2,4,5-TRICHLOROPHENOL	95-95-4	µg/l	SW8270	5.7	U	5.3	5	U	5.4	U	5.4	U	5.9	UJ
2,4,6-TRICHLOROPHENOL	1988-06-02	µg/l	SW8270	5.7	U	5.3	5	U	5.4	U	5.4	U	5.9	UJ
2,4-DICHLOROPHENOL	120-83-2	µg/l	SW8270	5.7	U	5.3	5	U	5.4	U	5.4	U	5.9	UJ
2,4-DIMETHYLPHENOL	105-67-9	µg/l	SW8270	16.6	5.3	U	49.1	111	143	5.4	U	28.6		
2,4-DINITROPHENOL	51-28-5	µg/l	SW8270	23	UJ	21	UJ	20	UJ	22	UJ	22	UJ	
2,4-DINITROTOLUENE	121-14-2	µg/l	SW8270	2.3	U	2.1	U	2	U	2.2	U	2.2	U	
2,6-DINITROTOLUENE	606-20-2	µg/l	SW8270	2.3	U	2.1	U	2	U	2.2	U	2.2	U	
2-CHLORONAPHTHALENE	91-58-7	µg/l	SW8270	5.7	U	5.3	U	5	U	5.4	U	5.4	U	
2-CHLOROPHENOL	95-57-8	µg/l	SW8270	5.7	U	5.3	U	5	U	5.4	U	5.4	U	
2-METHYLNAPHTHALENE	91-57-6	µg/l	SW8270	23.2	2.1	U	74.6	49.5	56.4	2.2	U	9.5	J	
2-METHYLPHENOL	95-48-7	µg/l	SW8270	6.4	5.3	U	4.8	J	36	45.6	5.4	U	3.7	J
2-NITROANILINE	88-74-4	µg/l	SW8270	5.7	U	5.3	U	5	U	5.4	U	5.4	U	
2-NITROPHENOL	88-75-5	µg/l	SW8270	5.7	U	5.3	U	5	U	5.4	U	5.4	U	
3&4-METHYLPHENOL	34METPH	µg/l	SW8270	16.9	5.3	U	7.9	93	119	5.4	U	6.5	J	
3,3'-DICHLOROBENZIDINE	91-94-1	µg/l	SW8270	5.7	U	5.3	U	5	U	5.4	U	5.4	U	
3-NITROANILINE	1999-09-02	µg/l	SW8270	5.7	UJ	5.3	UJ	5	UJ	5.4	UJ	5.4	UJ	
4,6-DINITRO-2-METHYLPHENOL	534-52-1	µg/l	SW8270	23	UJ	21	U	20	UJ	22	U	22	U	
4-BROMOPHENYL PHENYL ETHER	101-55-3	µg/l	SW8270	2.3	U	2.1	U	2	U	2.2	U	2.2	U	
4-CHLORO-3-METHYLPHENOL	59-50-7	µg/l	SW8270	5.7	U	5.3	U	5	U	5.4	U	5.4	U	
4-CHLOROANILINE	106-47-8	µg/l	SW8270	5.7	UJ	5.3	UJ	5	UJ	5.4	UJ	5.4	UJ	
ETHER	7005-72-3	µg/l	SW8270	2.3	U	2.1	U	2	U	2.2	U	2.2	U	
4-NITROANILINE	100-01-6	µg/l	SW8270	5.7	U	5.3	U	5	U	5.4	U	5.4	U	
4-NITROPHENOL	100-02-7	µg/l	SW8270	23	U	21	U	20	U	22	U	22	U	
ACENAPHTHENE	83-32-9	µg/l	SW8270	34	3.36		110	128	141	0.469		45.9	J	
ACENAPHTHYLENE	208-96-8	µg/l	SW8270	0.588	J	0.21	U	1.89	J	0.783	0.22	U	3.06	J
ACETOPHENONE	98-86-2	µg/l	SW8270	5.7	U	5.3	U	5	U	5.4	U	5.4	U	
ANTHRACENE	120-12-7	µg/l	SW8270	11.6	0.472		16.5	124	132	0.412		20.1		
ATRAZINE	1912-24-9	µg/l	SW8270	5.7	U	5.3	U	5	U	5.4	U	5.4	U	
BENZO(A)ANTHRACENE	56-55-3	µg/l	SW8270	3.35	0.11	U	5.7	2.84	2.59	0.518		29.9		
BENZO(A)PYRENE	50-32-8	µg/l	SW8270	2.9	0.11	U	4.58	2.38	1.97	0.319		33.5		
BENZO(B)FLUORANTHENE	205-99-2	µg/l	SW8270	3.1	0.21	U	4.6	2.67	2.23	0.489		31.7		
BENZO(G,H,I)PERYLENE	191-24-2	µg/l	SW8270	2.07	0.21	U	2.94	1.27	1.09	0.27		22.4		
BENZO(K)FLUORANTHENE	207-08-9	µg/l	SW8270	3	0.21	U	2.7	1.8	J	1.01	0.22	U	18.3	
BIS(2-CHLOROETHOXY)METHANE	111-91-1	µg/l	SW8270	2.3	U	2.1	U	2	U	2.2	U	2.2	U	
BIS(2-CHLOROETHYL)ETHER	111-44-4	µg/l	SW8270	2.3	U	2.1	U	2	U	2.2	U	2.2	U	
BIS(2-CHLOROISOPROPYL)ETHER	39638-32-9	µg/l	SW8270	2.3	U	2.1	U	2	U	2.2	U	2.2	U	
BIS(2-ETHYLHEXYL)PHTHALATE	117-81-7	µg/l	SW8270	2.3	U	2.1	U	2	U	2.2	U	2.2	U	
BUTYLBENZYL PHTHALATE	85-68-7	µg/l	SW8270	2.3	U	2.1	U	2	U	2.2	U	2.2	U	
CAPROLACTAM	105-60-2	µg/l	SW8270	2.3	U	2.1	UJ	2	UJ	2.2	UJ	2.2	U	
CARBAZOLE	86-74-8	µg/l	SW8270	37.8	2.1	U	121	316	332	2.2	U	2.2	U	
CHRYSENE	218-01-9	µg/l	SW8270	2.87	0.21	U	4.66	2.28	2.03	0.348		30.5		
DI-N-BUTYL PHTHALATE	84-74-2	µg/l	SW8270	2.3	U	2.1	U	2	U	2.2	U	2.2	U	
DI-N-OCTYL PHTHALATE	117-84-0	µg/l	SW8270	2.3	U	2.1	U	2	U	2.2	U	2.2	U	
DIBENZO(A,H)ANTHRACENE	53-70-3	µg/l	SW8270	0.574	0.21	U	0.797	0.411	0.345	0.22	U	3.99		
DIBENZOFURAN	132-64-9	µg/l	SW8270	13.4	5.3	U	48.6	64.4	70.6	5.4	U	16.3	J	
DIETHYL PHTHALATE	84-66-2	µg/l	SW8270	2.3	U	2.1	U	2	U	2.2	U	2.2	U	
DIMETHYL PHTHALATE	131-11-3	µg/l	SW8270	2.3	U	2.1	U	2	U	2.2	U	2.2	U	

J - Estimated Value; detected between the RL and MDL
ND - Not Detected
U - Analyte not detected above the MDL
D - Analyte reported from a diluted extract

Table A-3
Semi-Volatile Organic Compounds (SVOCs) in Groundwater - All Analytical Results
Block 93 Vapor Intrusion Evaluation
Edgewater, NJ

Parameter	Parameter Code	Units	Location:	TWP-SB28	TWP-SB29	TWP-SB30	TWP-SB31	TWP-SB31	TWP-SB32	TWP-SB33							
			Field Sample ID:	TWP-SB28-060507	TWP-SB29-060607	TWP-SB30-060507	DUP-060607-GW	TWP-SB31-060607	TWP-SB32-060607	TWP-SB33-060407							
			Date:	6/5/2007	6/6/2007	6/5/2007	6/6/2007	6/6/2007	6/6/2007	6/4/2007							
			Start Depth:	8	7.5	8	7.5	7.5	6.5	5							
			End Depth:	9	8.5	9	8.5	8.5	7.5	6							
			Depth Units:	ft	ft	ft	ft	ft	ft	ft							
Analytical Method																	
FLUORANTHENE	206-44-0	µg/l	SW8270	15	0.21	U	26.5	23.7	23.6	0.671	68.2						
FLUORENE	86-73-7	µg/l	SW8270	21	1.38		52.4	65.5	69.8	0.392	22.8	J					
HEXACHLOROBENZENE	118-74-1	µg/l	SW8270	0.023	U	0.021	U	0.02	U	0.022	U	0.024	U				
HEXACHLOROBUTADIENE	87-68-3	µg/l	SW8270	2.3	U	2.1	U	2	U	2.2	U	2.4	U				
HEXACHLOROCYCLOPENTADIENE	77-47-4	µg/l	SW8270	23	U	21	U	20	U	22	U	24	U				
HEXACHLOROETHANE	67-72-1	µg/l	SW8270	5.7	U	5.3	U	5	U	5.4	U	5.9	U				
INDENO(1,2,3-CD)PYRENE	193-39-5	µg/l	SW8270	1.84		0.21	U	2.71		1.26		0.252		20.5			
ISOPHORONE	78-59-1	µg/l	SW8270	2.3	U	2.1	U	2	U	2.2	U	2.4	U				
N-NITROSO-DI-N-PROPYLAMINE	621-64-7	µg/l	SW8270	2.3	U	2.1	U	2	U	2.2	U	2.4	U				
N-NITROSODIPHENYLAMINE	86-30-6	µg/l	SW8270	5.7	U	5.3	U	5	U	5.4	U	5.9	U				
NAPHTHALENE	91-20-3	µg/l	SW8270	223		0.21	U	873		380		457		0.644	533	J	
NITROBENZENE	98-95-3	µg/l	SW8270	2.3	U	2.1	U	2	U	2	U	2.2	U	2.4	U		
PENTACHLOROPHENOL	87-86-5	µg/l	SW8270	0.34	U	0.32	U	0.3	U	0.3	U	0.33	U	0.32	U	0.35	U
PHENANTHRENE	1985-01-08	µg/l	SW8270	43.8		1.24		86		121		129		1.11		49.7	J
PHENOL	108-95-2	µg/l	SW8270	2.9	J	5.3	U	5	U	13.6		17.3		5.4	U	5.9	U
PYRENE	129-00-0	µg/l	SW8270	13.2		0.21	U	20.3		15.9		15		0.637		57.5	

J - Estimated Value; detected between the RL and MDL
ND - Not Detected
U - Analyte not detected above the MDL
D - Analyte reported from a diluted extract

Table A-4
Semi-Volatile Organic Compounds (SVOCs) in Groundwater - Detected Compounds
Block 93 Vapor Intrusion Evaluation
Edgewater, NJ

Parameter	Parameter Code	Units	Location:	TWP-SB28	TWP-SB29	TWP-SB30	TWP-SB31	TWP-SB31	TWP-SB32	TWP-SB33
			Field Sample ID:	TWP-SB28-060507	TWP-SB29-060607	TWP-SB30-060507	DUP-060607-GW	TWP-SB31-060607	TWP-SB32-060607	TWP-SB33-060407
			Date:	6/5/2007	6/6/2007	6/5/2007	6/6/2007	6/6/2007	6/6/2007	6/4/2007
			Start Depth:	8	7.5	8	7.5	7.5	6.5	5
			End Depth:	9	8.5	9	8.5	8.5	7.5	6
			Depth Units:	ft	ft	ft	ft	ft	ft	ft
			Analytical Method							
1,1'-BIPHENYL	92-52-4	µg/l	SW8270	5.8		6	8.1	9		2.1 J
2,4-DIMETHYLPHENOL	105-67-9	µg/l	SW8270	16.6		49.1	111	143		28.6
2-METHYLNAPHTHALENE	91-57-6	µg/l	SW8270	23.2		74.6	49.5	56.4		9.5 J
2-METHYLPHENOL	95-48-7	µg/l	SW8270	6.4		4.8 J	36	45.6		3.7 J
3&4-METHYLPHENOL	34METPH	µg/l	SW8270	16.9		7.9	93	119		6.5 J
ACENAPHTHENE	83-32-9	µg/l	SW8270	34	3.36	110	128	141	0.469	45.9 J
ACENAPHTHYLENE	208-96-8	µg/l	SW8270	0.588 J		1.89 J	0.783			3.06 J
ANTHRACENE	120-12-7	µg/l	SW8270	11.6	0.472	16.5	124	132	0.412	20.1
BENZO(A)ANTHRACENE	56-55-3	µg/l	SW8270	3.35		5.7	2.84	2.59	0.518	29.9
BENZO(A)PYRENE	50-32-8	µg/l	SW8270	2.9		4.58	2.38	1.97	0.319	33.5
BENZO(B)FLUORANTHENE	205-99-2	µg/l	SW8270	3.1		4.6	2.67	2.23	0.489	31.7
BENZO(G,H,I)PERYLENE	191-24-2	µg/l	SW8270	2.07		2.94	1.27	1.09	0.27	22.4
BENZO(K)FLUORANTHENE	207-08-9	µg/l	SW8270	3		2.7	1.8 J	1.01		18.3
CARBAZOLE	86-74-8	µg/l	SW8270	37.8		121	316	332		36.6 J
CHRYSENE	218-01-9	µg/l	SW8270	2.87		4.66	2.28	2.03	0.348	30.5
DIBENZO(A,H)ANTHRACENE	53-70-3	µg/l	SW8270	0.574		0.797	0.411	0.345		3.99
DIBENZOFURAN	132-64-9	µg/l	SW8270	13.4		48.6	64.4	70.6		16.3 J
FLUORANTHENE	206-44-0	µg/l	SW8270	15		26.5	23.7	23.6	0.671	68.2
FLUORENE	86-73-7	µg/l	SW8270	21	1.38	52.4	65.5	69.8	0.392	22.8 J
INDENO(1,2,3-CD)PYRENE	193-39-5	µg/l	SW8270	1.84		2.71	1.26	1.07	0.252	20.5
NAPHTHALENE	91-20-3	µg/l	SW8270	223		873	380	457	0.644	533 J
PHENANTHRENE	1985-01-08	µg/l	SW8270	43.8	1.24	86	121	129	1.11	49.7 J
PHENOL	108-95-2	µg/l	SW8270	2.9 J			13.6	17.3		
PYRENE	129-00-0	µg/l	SW8270	13.2		20.3	15.9	15	0.637	57.5

J - Estimated Value; detected between the RL and MDL
ND - Not Detected
U - Analyte not detected above the MDL
D - Analyte reported from a diluted extract

Attachment B

Primary Screening of Constituents of Potential Concern
(USEPA, 2002)

Table B-1 - Primary Screening of Volatile Organic Compounds in Groundwater

Table B-2 - Primary Screening of Semi-Volatile Organic Compounds in Groundwater

Table B-1

Primary Screening of Volatile Organic Compounds in Groundwater
 Block 93 Vapor Intrusion Evaluation
 Edgewater, NJ

Constituent	Is Chemical Sufficiently Volatile?	Detected in Groundwater?	Evaluate Potential Vapor Intrusion Pathway?	Comments
Acetone	YES	YES		Detected below the reporting limit
Benzene	YES	YES	YES	
Bromodichloromethane	YES			
Bromoform	YES			
Bromomethane	YES			
2-Butanone (MEK)	YES			
Carbon disulfide	YES	YES		Detected below the reporting limit
Carbon tetrachloride	YES			
Chlorobenzene	YES			
Chloroethane	YES			
Chloroform	YES			
Chloromethane	YES			
Cyclohexane	not applicable	YES		Detected below the reporting limit
1,2-Dibromo-3-chloropropane	YES			
Dibromochloromethane	not applicable			
1,2-Dibromoethane	YES			
1,2-Dichlorobenzene	YES			
1,3-Dichlorobenzene	YES			
1,4-Dichlorobenzene	YES			
Dichlorodifluoromethane	YES			
1,1-Dichloroethane	YES			
1,2-Dichloroethane	YES			
1,1-Dichloroethene	not applicable			
cis-1,2-Dichloroethene	not applicable			
trans-1,2-Dichloroethene	not applicable			
1,2-Dichloropropane	YES			
cis-1,3-Dichloropropene	not applicable			
trans-1,3-Dichloropropene	not applicable			
Ethylbenzene	YES	YES	YES	
Freon 113	YES			
2-Hexanone	not applicable			
Isopropylbenzene	not applicable	YES		Detected at lower concentrations than other aromatic VOCs
Methyl Acetate	YES			
Methylcyclohexane	YES	YES		Detected below the reporting limit
MTBE	YES	YES		Detected below the reporting limit
4-Methyl-2-pentanone (MIBK)	YES			
Methylene chloride	YES			
Styrene	YES			
1,1,2,2-Tetrachloroethane	YES			
Tetrachloroethene	YES			
Toluene	YES	YES	YES	

Table B-1

Primary Screening of Volatile Organic Compounds in Groundwater
Block 93 Vapor Intrusion Evaluation
Edgewater, NJ

Constituent	Is Chemical Sufficiently Volatile?	Detected in Groundwater?	Evaluate Potential Vapor Intrusion Pathway?	Comments
1,2,4-Trichlorobenzene	YES			
1,1,1-Trichloroethane	YES			
1,1,2-Trichloroethane	YES			
Trichloroethene	YES			
Trichlorofluoromethane	YES			
Vinyl chloride	YES			
Xylene (total)	YES	YES	YES	

Notes:

not applicable - not identified as a volatile constituent in EPA's draft vapor intrusion guidance (USEPA, 2002).

Table B-2

Primary Screening of Semi-Volatile Organic Compounds in Groundwater
Block 93 Vapor Intrusion Evaluation
Edgewater, NJ

Constituent	Is Chemical Sufficiently Volatile?	Detected in Groundwater?	Evaluate Potential Vapor Intrusion Pathway?	Comments
2-Chlorophenol	YES			
4-Chloro-3-methyl phenol	not applicable			
2,4-Dichlorophenol	NO			
2,4-Dimethylphenol	NO	YES		
2,4-Dinitrophenol	NO			
4,6-Dinitro-o-cresol	not applicable			
2-Methylphenol	not applicable	YES		
3&4-Methylphenol	not applicable	YES		
2-Nitrophenol	not applicable			
4-Nitrophenol	NO			
Pentachlorophenol	NO			
Phenol	NO	YES		
2,4,5-Trichlorophenol	NO			
2,4,6-Trichlorophenol	NO			
Acenaphthene	YES	YES		
Acenaphthylene	not applicable	YES		
Acetophenone	YES			
Anthracene	YES	YES		
Atrazine	not applicable			
Benzaldehyde	YES			
Benzo(a)anthracene	not applicable	YES		
Benzo(a)pyrene	NO	YES		
Benzo(b)fluoranthene	YES	YES		
Benzo(g,h,i)perylene	not applicable	YES		
Benzo(k)fluoranthene	NO	YES		Target soil gas concentration exceeds maximum theoretical soil gas concentration (pathway incomplete) (EPA, 2002).
4-Bromophenyl phenyl ether	not applicable			
Butyl benzyl phthalate	not applicable			
1,1'-Biphenyl	not applicable	YES		
2-Chloronaphthalene	not applicable			
4-Chloroaniline	not applicable			
Carbazole	NO	YES		
Caprolactam	not applicable			
Chrysene	YES	YES		Health-based target breathing concentration exceeds maximum possible chemical vapor concentration (pathway incomplete) (EPA, 2002)
bis(2-Chloroethoxy)methane	not applicable			
bis(2-Chloroethyl)ether	YES			
bis(2-Chloroisopropyl)ether	YES			
4-Chlorophenyl phenyl ether	not applicable			
2,4-Dinitrotoluene	NO			
2,6-Dinitrotoluene	NO			
3,3'-Dichlorobenzidine	not applicable			
Dibenzo(a,h)anthracene	not applicable	YES		Not identified as a volatile constituent in USEPA's draft vapor intrusion guidance. As with other PAHs, the target soil gas concentration exceeds maximum theoretical soil gas concentration (pathway incomplete).

Table B-2

Primary Screening of Semi-Volatile Organic Compounds in Groundwater
 Block 93 Vapor Intrusion Evaluation
 Edgewater, NJ

Constituent	Is Chemical Sufficiently Volatile?	Detected in Groundwater?	Evaluate Potential Vapor Intrusion Pathway?	Comments
Dibenzofuran	YES	YES	YES	
Di-n-butyl phthalate	not applicable			
Di-n-octyl phthalate	not applicable			
Diethyl phthalate	not applicable			
Dimethyl phthalate	not applicable			
bis(2-Ethylhexyl)phthalate	NO			
Fluoranthene	YES	YES		
Fluorene	YES	YES		Target soil gas concentration exceeds maximum theoretical soil gas concentration (pathway incomplete) (EPA, 2002).
Hexachlorobenzene	YES			
Hexachlorobutadiene	not applicable			
Hexachlorocyclopentadiene	YES			
Hexachloroethane	YES			
Indeno(1,2,3-cd)pyrene	NO	YES		
Isophorone	NO			
2-Methylnaphthalene	YES	YES		
2-Nitroaniline	not applicable			
3-Nitroaniline	not applicable			
4-Nitroaniline	not applicable			
Naphthalene	YES	YES	YES	
Nitrobenzene	YES			
N-Nitroso-di-n-propylamine	not applicable			
N-Nitrosodiphenylamine	NO			
Phenanthrene	not applicable	YES		
Pyrene	YES	YES		Target soil gas concentration exceeds maximum theoretical soil gas concentration (pathway incomplete) (EPA, 2002).

Notes:

not applicable - not identified as a volatile constituent in EPA's draft vapor intrusion guidance (USEPA, 2002).